PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT

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BY

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Dedicated

To

my Family

&

Teachers

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Dr. Vipul Bakshi

LIST OF ABBREVIATIONS

AAST	American Association of Surgery in Trauma
ATLS	Advanced Trauma Life Support
AUA	American Urological Association
CECT	Contrast Enhanced Computed Tomography
CT	Computed Tomography
DCS	Damage control surgery
DJ	Double J
DMSA	Dimercapto-Succinic Acid
EAU	European Association of Urology
I/V	Intravenous
ICU	Intensive Care Unit
IVP	Intravenous Pyelography
MVA	Motor vehicle accident
NOM	Nonoperative management
PCD	Percutaneous drain
UPJ	Uretero-pelvic junction
US	Ultrasound

ABSTRACT

INTRODUCTION: There is a general consensus on the conservative management of minor renal injuries; however, there remains a divergence of opinion on management of major renal trauma with strong advocates of conservative as well as aggressive surgical management. Also, there are not many documented studies which elaborate renal function outcome after renal trauma

AIMS: To determine the pattern of renal injuries in blunt trauma abdomen and study the effect of management protocols in the outcome.

MATERIALS AND METHODS: This prospective study was conducted in Department of Urology & kidney Transplant, Dayanand Medical College & Hospital and included all patients of blunt renal trauma. Patients were studied for their management and outcomes.

RESULTS: A total of 18 patients were enrolled who had blunt renal injury. Mean age was 26.72 years. Majority of the patients were male (83.3%). Most common mode of injury leading to renal injuries was motor vehicle accidents (72.2%). Most common associated organ injured was Liver (61%). Mean hospital stay was 10.27 days. Hematuria was found to occur in 55.6% cases. There were 3 patients (16.7%) each of Grade I, Grade II, Grade III and Grade V renal injury. Grade IV renal injury was more common (33.3%). All Patient of Grade I, II and III renal injury were managed conservatively. Out of 6 patients of Grade IV trauma, 5 were managed conservatively and one underwent angioembolization. Out of 3 patients of Grade V renal trauma, one was managed conservatively, one patient underwent nephrectomy and one underwent angioembolization. None of the patients belonging to Grade I, II and III renal injury group had any urological complications. Three patients of Grade IV renal injury had complications. One patient had perinephric abscess and two had urinoma. One patient in Grade V group had perinephric abscess with fever. Both cases of urinoma were treated with DJ stenting. One patient of perinephric abscess was treated with PCD insertion and other treated with I/V antibiotics. Twelve patients completed this study with respect to DMSA scans. Mean early function of injured kidney was 33.25% and mean late function was 37.92%. (p=0.002).

CONCLUSION: Majority of the patients can be managed conservatively. High Grade injuries may require surgery or angioembolization in selected cases. There is improvement of function of injured kidney with passage of time in the majority of the patients more significantly in high grade injuries.

Key words: Blunt renal trauma, angioembolization, DMSA

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INTRODUCTION

Trauma is the leading cause of death and disability worldwide. The technological advancement in automobile industry has greatly contributed to the development of the world, but it is a field where sometimes priority is given to speed over safety. Thus, motor vehicle accidents now rank fourth in order among the leading cause of death. In person less than 30 years, trauma is responsible for more deaths than all other illnesses put together. They are the commonest cause of non-penetrating abdominal trauma.[1] Despite its relatively protected retroperitoneal position, the kidney is the most commonly injured organ of the genitourinary system during trauma.[2]

Renal trauma occurs in 8-10% of all blunt and penetrating abdominal injuries.[3] Incidence is higher in male with male to female ratio of 3:1.[4] Serious renal injuries are frequently associated with injuries to other organs. It is more frequent in the young population with a mean age range from 31 to 38 years.[5] Multi-organ involvement occurs in 75% patient with blunt trauma abdomen.[6]

Motor vehicle accidents were the most common cause of injury, accounting for 48.3% of all renal injuries.[7] The mechanism of visceral damage in blunt force injuries can be explained by three mechanisms. The first is when rapid deceleration causes differential movement among adjacent structures. As a result, shear forces are created and cause hollow, solid, visceral organs, and vascular pedicles to tear, especially at relatively fixed points of attachment. For instance, the distal aorta is attached to the thoracic spine and decelerates much more quickly than the relatively mobile aortic arch. As a result, shear forces in the aorta may cause it to rupture.[8] Similar situation can occur at the renal pedicles, leading to vascular thrombosis and renal infarction. The second is when intraabdominal contents are crushed between the anterior abdominal wall and the vertebral column or posterior thoracic cage. This produces a crushing effect, to which solid viscera (e.g. spleen, liver, and kidneys) is

especially vulnerable. The third is external compression forces that result in a sudden dramatic rise in the intraabdominal pressure and culminate in the rupture of a hollow visceral organ (in accordance with the principles of Boyle's law).[9]

Seventy five to eighty percent of renal injuries are classified as minor injuries (Grade I-III). Renal injuries are graded using the classification of the organ injury severity committee from the American Association of Surgery in Trauma (AAST).[10] This includes extent of hematoma, depth of laceration, involvement of collecting system and severity of vascular injury.

The evolution in management of renal trauma has been made possible by advances in imaging. CT scanning is more sensitive and specific than IVP and Ultrasound scanning. It provides greater anatomical detail and associated injuries to any intra-abdominal organs. For renal injury, a scan should also be performed after injection of intravenous contrast to delineate the collecting system (delayed phase). CT scanning is the only imaging modality that can provide information required to grade renal injuries as part of the AAST renal injury grading system. For this purpose, there needs to be an arterial, venous and a delayed excretory phase to assess all pedicle injuries.[11] Therefore, CT is the imaging of choice in renal trauma.[12]

There is a general consensus on the conservative management of minor renal injuries; however, there remains a divergence of opinion on management of major renal trauma with strong advocates of conservative as well as aggressive surgical management. Most patients with major renal trauma can be followed expectantly, with delayed intervention only as needed due to improvements in imaging modalities.[13] Urinalysis provides rapidly available information in patients who may have a renal laceration. Sonography may be used in patients with blunt trauma abdomen and possible renal injury. Indications for surgery in renal trauma are avulsion of the renal pelvis, injuries to vascular pedicle and life-

threatening hemodynamic instability.[14] The relative indications for renal exploration can be nonviable tissue, urinary extravasation, incomplete staging and arterial thrombosis. These injuries may coexist with bleeding and it's this combination that lead to renal exploration.[15] Vascular injury can also be effectively treated with angiographic procedures like super selective renal embolization.[16] Also, there are not many documented studies which elaborate renal function outcome after renal trauma. Henceforth, this study has been planned to study the pattern of renal injury in blunt trauma abdomen, its management and outcome with respect to renal functions at our institute.

AIMS AND OBJECTIVES

1. To determine the pattern of renal injuries in blunt trauma abdomen.
2. To study the effect of management protocols in the outcome.

REVIEW OF LITERATURE

Blunt renal trauma occurs in all age groups. It is more commonly found in younger age group. This is probably because patient in this age group lead more active life and have more outdoor activities. Patel et al in 2014 conducted an Observational Cross Sectional Combined Retrospective and Prospective study of 25 patients of blunt renal injuries and found out maximum incidence of blunt renal trauma was seen in the age group of 11-20 years of age (Mean age-22.76 years).[17] In another study of 65 patients in 2004, Iqbal et al found out mean age of the 65 patients was 29±12.1 years ranging from 18 to 65 years.[18] In a study in 2011 by Aragona et al, 30 out of 45 patients of renal trauma were younger than 30 years of age.[19]

Road traffic accident was the commonest mode of injury in blunt trauma. In a systematic review conducted by Voelzke and Leddy, blunt renal trauma in the adult population was caused primarily by motor vehicle accidents (MVAs) (63%), followed by falls (22%), sports (11%) and pedestrian accidents (4%).[20] MVAs and motorcycle accidents were the most common cause of injury, accounting for 48.3% of all renal injuries.[21] In a study in 2011 by Aragona et al, out of 45, motor vehicle accidents accounted for 38 injuries (84%), falls for six (14%) and a sports accident for one case.[19] Iqbal et al found Forty five (69%) were involved in motor vehicle accidents.[18]

Incidence is higher in male with male to female ratio of 3:1.[4] In a study by Mangaiyarkarasi et al in 2017, of the total of 38 patients who sustained renal injuries, 84% (32 out of 38) were males. Only 6 females (16%) sustained renal injuries in their series.[22] In 2014, Patel et al found out 92% of patients with renal injury to be male.[17] Iqbal et al found 59 out of 65 patients to be male.[18]

The pathophysiology of blunt renal trauma is not completely understood but it seems that the major elements that cause the trauma are deceleration and acceleration forces. The kidney is covered by fat and

the Gerota's fascia in the retroperitoneum, and the renal pedicle and uretero-pelvic junction (UPJ) are the major attachment elements; therefore, deceleration forces on these elements may cause renal injury like rupture or thrombosis.[23] Acceleration forces may cause collision of the kidney in its surrounding elements, like the ribs and spine, and cause parenchymal and vascular injury.[24]

Hematuria associated with renal trauma is not a predictable indicator of grade of renal injury. The degree of hematuria does not correlate with the severity of injury. Mild injuries including simple hematomas can produce gross hematuria.[25] The presence of gross hematuria (60%), microscopic hematuria (13%) and absence of hematuria (12%) indicates that evaluation of patient of renal trauma should be based on both clinical judgment and the presence of hematuria.[26] Hai et al had reported absence hematuria in 2.8% cases of major injuries.[27] Hematuria was present in (64%) of the patients in the study by Patel et al.[17] In a study by Herschorn et al in 1991, 68% of patients of renal trauma had hematuria.[28]

In 2014, Patel et al demonstrated lesions associated with other organs in over 70% of patients. Majority of the extra abdominal injuries include chest injuries (fractured ribs, hemopneumothorax and lung contusions) and traumatic brain injuries. The spleen (48%) is the commonly affected solid organ followed by liver (20%). Out of 25 patients of blunt renal injury all underwent CECT abdomen, of them splenic injury was detected in (32%) patients and liver injury was also detected in (32%) patients. Chest injury was associated in (56%) of the patients, of them most common was rib fractures.[17]

In a study in 2011 by Aragona et al, out of 45 patients, 26 (58%) had left side and 19 (42%) had right side renal injury.[19]

The approach to management of patients with major abdominal trauma has been standardized according to set protocols with the development of structured advanced trauma life support (ATLS)

guidelines, the development of policies for minimizing coagulopathy with massive transfusions, and the use of damage control surgery (DCS). Initial management of an adult with major trauma or suspected renal injury follows ATLS guidelines. The principles of ATLS are to identify and treat the immediate life-threatening injuries first by the assessment of Airway, Breathing, Circulation, Disability, and Exposure/Environment. Renal injuries may present in the primary survey as hypovolemic shock; however, most will be identified in the secondary survey after imaging.

The development of massive transfusion protocols in resuscitation has seen significant reductions in 24-hour mortality.[29] They aim to reduce traumatic coagulopathy through the administration of fresh frozen plasma, platelets, and coagulation products, in addition to packed red blood cells. DCS involves a staged surgical approach to injury identification and repair to minimize extensive procedures on unstable patients. DCS aims to reduce the lethal triad of acidosis, hypothermia, and coagulopathy by gaining early control of bleeding and contamination and preventing of further heat loss.

Ultrasound (US) is used to define free fluid in the setting of trauma, but it is inferior to CT in its resolution and the ability to accurately describe renal injury. Ultrasound examination is unable to distinguish fresh blood from extravasated urine, and cannot identify vascular pedicle injuries and segmental infarct.[30] Ultrasound can be used for follow up of hydronephrosis, renal laceration managed nonoperatively and postoperative fluid collection. The absence of radiation, which is one of the main advantages of Ultrasound, is very relevant for pediatric patients.[31]

The goal of initial imaging is to grade the renal injury, demonstrate contralateral kidney and preexisting renal abnormalities, and identify injuries to other organs. The decision to obtain an initial image is based on clinical aspects and the mechanism of injury. According to the European Association of Urology (EAU)[32] and the American Urological Association (AUA) guidelines,[33] CT should be performed in all hemodynamically

stable blunt trauma patients with either gross hematuria or patients presenting with microscopic hematuria and hypotension (systolic blood pressure <90 mm Hg) at presentation. It should be clear that hemodynamic instability does not allow the diagnostic use of a CT. Moreover, CT should be performed when the mechanism of injury or the physical examination findings are suggestive of renal injury (i.e. rapid deceleration, a rib fracture, substantial flank ecchymosis, and every penetrating injury of the abdomen, flank or lower chest)

Intravenous contrast-medium enhanced computed tomography (CECT) is currently the gold standard imaging method for hemodynamically stable patients with blunt and penetrating renal trauma.[34] It is widely available and it can quickly and accurately locate renal and other organ injuries by the anatomic and functional information that is essential for accurate staging. CT for renal trauma should include four phases: precontrast, postcontrast arterial (35 s post intravenous injection), postcontrast nephrogenic/portal venous (75 s post intravenous injection) and delayed (5–10 min post intravenous injection).[35] The precontrast phase can identify renal calculi, which affect management,[36] active bleeding or intraparenchymal hematoma.[34] Postcontrast phases identify parenchymal and vascular damage, including the presence of active extravasation of contrast, other solid organ damage (e.g. liver and pancreas) and physiological variants that may affect management.[34] The delayed phase can visualize the collecting system and possible ureteric injury. In 2010, Dugi et al showed a correlation between important CT finding such as large perirenal hematoma, intravascular contrast extravasation, medial renal laceration and the need for urgent intervention.[37]

The goal of reimaging is to diagnose possible complications and to evaluate clinical deterioration. Reimaging is indicated for patients with clinical signs of complications, such as fever, worsening flank pain, ongoing blood loss and abdominal distension.[31]

Garcia HA et al [38] in their study have shown that the average stay in hospital was 8 days while in the study by Moudouni SM et al [39] the mean hospital stay was 16.3 days. The period of hospital stay may not be comparable as social customs, free medicare, literacy of the population, financial capability and availability of transport may determine the mean hospital stay over and above the actual clinical condition. Patel et al demonstrated mean hospital stay for the conservative group patients was 11.34 days and mean hospital stay for the operative group patients was 22 days.[17]

The Injury Severity Scale for the kidney is an anatomic-based description, developed by the American Association for the Surgery of Trauma (AAST) in 1989 to facilitate clinical research and it has been validated for clinical use.[40] It classifies renal injuries into five grades in order of increasing severity. It is widely used and is a powerful predictor of clinical outcome. The grade directly correlates with the need for intervention, nephrectomy, dialysis, and mortality.[41]

AAST KIDNEY INJURY SCALE

Grade I:

- Subcapsular hematoma and/or parenchymal contusion without laceration

Grade II:

- Perirenal hematoma confined to Gerota fascia
- Renal parenchymal laceration ≤1 cm depth without urinary extravasation

Grade III

- Renal parenchymal laceration >1 cm depth without collecting system rupture or urinary extravasation
- Any injury in the presence of a kidney vascular injury or active bleeding contained within Gerota fascia

Grade IV

- Parenchymal laceration extending into urinary\ collecting system with urinary extravasation
- Renal pelvis laceration and/or complete ureteropelvic disruption
- Segmental renal vein or artery injury
- Active bleeding beyond Gerota fascia into the retroperitoneum or peritoneum
- Segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding

Grade V

- Main renal artery or vein laceration or avulsion of hilum
- Devascularized kidney with active bleeding
- Shattered kidney with loss of identifiable parenchymal renal anatomy

MANAGEMENT OF RENAL TRAUMA

There has been a shift over the past two decades towards conservative management, which forms the mainstay of treatment and has been reported in all grades of injury. Patients with Grades 1 through 4 injuries can generally be managed conservatively. It is important, however, to appreciate that there are significant clinical differences between a Grade 4 laceration and a Grade 4 unstable vascular injury, and that the latter may necessitate intervention. Grade 5 injuries are more controversial, as traditional treatment involves intervention and possibly nephrectomy. However, successful conservative management has been reported and it is important to understand that there is a spectrum of Grade 5 injuries from the less severe (avascular kidneys with minimal hematoma) to more severe (burst kidney or uncontained pedicle avulsion).[21] Sahai et al determined the feasibility of a non-operative approach to blunt grade V renal injury and found that conservative management is feasible in patients who are hemodynamically stable at presentation.[42] Matthews et al in 1997 did a retrospective study comprising of 126 patients with blunt renal injury in which 90% patients

were treated conservatively. Overall, results were excellent in 87%; there were four deaths unrelated to the renal injury and two patients who required dialysis.[43]

Conservative management consists of bed rest with close monitoring. The fragile kidney is vulnerable to further disruption by mechanical forces in the initial period. There should be regular clinical examination and twice daily checks for decreases in hematocrit and renal function. Resuscitation with intravenous fluids and blood transfusion should be provided if required and critical care involved at an early stage.[44]

The goal of renal exploration following renal trauma are control of hemorrhage and real salvage. Indications for surgery in renal trauma are avulsion of the renal pelvis, injuries to vascular pedicle and life-threatening hemodynamic instability.[14] The relative indications for renal exploration can be nonviable tissue, urinary extravasation, incomplete staging and arterial thrombosis. In the case of exploring an injured kidney, nephron sparing is the primary goal, but in many cases total nephrectomy may be deemed as inevitable for uncontrolled hemorrhage.

Grade I–II renal trauma patients should be treated conservatively. In several studies, there was no need for a nephrectomy in any patient and rare indications for renal exploration.[45,46]

In a study by Buckley et al in 2011, the nephrectomy rate in Grade III injury was very low (1.8%) in another study (3/171).[47] Aragona and colleagues found that among 21 patients with grade III blunt renal trauma the nephrectomy rate was 9% but when it was divided into two periods (2001–5, 2006–10) it was found that during the second period there were no nephrectomies. This is attributed to the growing use of angioembolization.[19] Therefore, patients with grade III renal trauma can be treated with NOM, by active monitoring and use of angioembolization if indicated.

Most grade IV blunt renal injuries were treated nonoperatively, with a low incidence of nephrectomy in a study by Santucci RA et al, as they

reported that in 57 patients had Grade IV renal injuries, 84.2% were managed conservatively, while the remaining 15.8% of them underwent renal exploration.[48] There is a trend toward NOM for patients with grade IV blunt trauma with better outcome, which is attributed to the use of angioembolization.[19] Interventional procedures maybe indicated in more stable patients as well as in postoperative patients with persistent or recurrent haematuria.[49] The main indications for angiography are: embolization for active haemorrhage, pseudo-aneurysm and vascular fistula.[50]

Lanchon and colleagues presented their first-line NOM protocol in 149 patients with grade IV or V renal blunt trauma. NOM was successful in 82% of the patients, with higher success in patients with grade IV (89% versus 52%) and the predictors for NOM failure were higher grade and hemodynamic instability. Eighteen percent underwent angioembolization, 17% underwent ureteral stent insertion, and 18% required delayed surgery.[51] Van der Wilden and colleagues found that 77% (154/201) of patients with grade IV or V blunt renal trauma had successful NOM with no loss of kidney units. Age over 55 years and MVAs were the only two predictors for NOM failure.[52] According to these data, patients with grade IV–V blunt renal trauma who are hemodynamically stable should have the opportunity for NOM with active surveillance.[33]

In a retrospective review of 13 patients by Altmen et al in 2000 with Grade V blunt renal injury, six hemodynamically stable patients with a shattered but perfused kidney were successfully treated nonoperatively. Seven patients with either a nonperfused kidney or hemodynamic instability were treated operatively. The nonoperative group had fewer ICU days, significantly lower transfusion requirements, and fewer complications. A follow-up CT scan of nonoperatively treated patients revealed a functioning kidney in four of the six patients in which it was performed. No patients subsequently developed hypertension, leading the authors to conclude that conservative management of shattered but

perfused kidneys is feasible in hemodynamically stable patients with minimal transfusion requirements.[33]

In another review of 55 patients with renal trauma (95% blunt) by Goff et al, 69% of hemodynamically stable patients and 38% of hemodynamically unstable patients successfully managed nonoperatively. Operative exploration was primarily required for the treatment of associated injuries.[54]

COMPLICATIONS AND THEIR MANAGEMENT

Major hemorrhage is the immediate concern. Disruption of the kidney capsule or pedicle allows blood to surround the kidney. The retroperitoneum provides a degree of tamponade but expanding or pulsatile retroperitoneal hematomas are concerning for large volume hemorrhage.[55] Hemorrhage usually occurs within the initial two weeks and is more common in penetrating trauma. Delayed hemorrhage occurs in 13–25% of grade 3 or 4 injuries. This is usually due to the presence of a pseudoaneurysm or arteriovenous fistula.[21] It may present with falling hematocrit or there may be flank pain, a local mass with a bruit or hypertension. The usual presentation of an arteriovenous fistula is persistent hematuria. Both can initially be managed conservatively and are usually amenable to embolization.[44]

Disruption of the collecting system extravasates urine and an urinoma is formed. This is the most common complication occurring in 1–7% of all injuries and one quarter of high-grade injuries.[56] Delayed phase CT imaging is the study of choice in the diagnosis of urine leaks and urinomas. Urinomas may also be complicated by superinfection or perinephric abscess formation.[29] In most cases, a small urinoma will be reabsorbed spontaneously and further intervention is not needed. If the volume does not decrease, or if it increases, further intervention will be necessary such as ureteral stenting with or without percutaneous drain placement.[43] Robert et al in his study showed pyelonephritis (9%), residual perinephric fluid collection (36%) and ureteral stenting for urinary

extravasation in 36% cases.[57] Hass et al described a high salvage rate using ureteral stents in patients with renal trauma and urinary extravasation.[58] Alsikafi et al reported 9% patients with major blunt injury and urinary extravasation required ureteric stenting for persistent extravasation, while 91% had spontaneous resolution.[59]

Collections of static blood or urine provide a rich medium for bacterial proliferation. Bacteria can ascend the urinary tract or be contaminants from the gut in polytrauma. Renal trauma patients are therefore at a substantial risk of sepsis. Antimicrobials should be started when there are signs of sepsis or a urine leak is identified. Perinephric abscesses are common and should be drained by percutaneous or open surgical methods.[60]

A page kidney refers to a large perinephric hematoma causing acute hypertension. Renal vessel compression leads to renin activation and sodium retention. In the chronic situation; long-standing hematomas and fibrotic tissue can compress vessels which drive renin activation and secondary hypertension.[61] Incidence relates to the severity of renal injury, and patients with Grade 4 and 5 injuries should have periodic blood pressure monitoring in the long term. This is estimated to occur in less than 5% of cases but may be 29% in high-grade injuries.[62] Antihypertensives, surgical reconstruction or even nephrectomy may be required.[21]

Injuries with nonviable renal segments can be managed conservatively; however, these injuries are associated with a higher complication rate and the need for delayed intervention. Ischemia can drive renin activation. These patients require close monitoring.[21]

The risk of renal impairment will depend on preexisting renal disease, age, presence of single kidney, and associated multiorgan failure. One study showed the risk of requiring dialysis was 0.46% in a large review of all grades of renal trauma.[63] The need for dialysis was associated with

increasing AAST grade and age older than 40 years. If just high-grade injuries are analyzed, the risk may be as high as 6%.[64]

In a study in 2011 by Aragona et al, Among 18 grade 4 renal injury patients, five needed ureteral stenting and in one case a percutaneous drainage of a perinephric abscess was needed.[19]

In 2017, Min A Lee et al in their study of 62 renal injury patients found out 13 patients had complications (20%): four patients had urine leakage (6.5%); three had delayed bleeding (4.8%); two had hydronephrosis (3.2%); two had pseudoaneurysm (3.2%); one patient had an abscess; and one had renal failure. The Incidence of urological complications correlated with increasing grade (grade III=8.3%, grade IV=22.6%, and grade V=57.1%; p=0.021).[65]

In 2014, Patel et al found that out of 53 patients treated conservatively two (4%) developed fever and eight (15%) hypertension. Two (4%) patients of grade III underwent delayed exploration for perinephric collection.[18]

FOLLOW UP

The post-trauma follow-up goals are:

1) To clinically evaluate patients, regarding complaints, past medical history, family history, and findings in the physical examination

2) To evaluate renal function by using Dimercaptosuccinic acid (DMSA) renal scintigraphy to detect and quantify differences in renal function

3) To evaluate the incidence of arterial hypertension in the follow-up of these cases by using blood-pressure monitoring.

Nuclear scans are useful for tracking recovery, particularly following renal reconstruction**.** Assessment of residual renal function with Dimercapto-Succinic Acid Renal Scintigraphy (DMSA) is inconsistent but has been performed by some centers for injuries of grade III or above. One study looked at these results but the scans were performed between 1 and 818 days post injury. It is likely that early DMSA scanning offers no

long term information but it has been proposed that renal function six months post injury is not significantly different to renal function on DMSA scanning 8 days post injury.[66]

In 2017, Kumar K et al did a prospective study to compare renal function with DMSA scan within 7 days and 3 months after trauma for assessment of early and delayed relative function of injured kidney respectively. Total 32 patients fulfilled the inclusion and exclusion criteria and completed the study. They found out that the mean early relative function of the injured kidney (35.7%) improved significantly at 3 months (39.6%) ($p < 0.001$). They concluded that the improvement of function of injured kidney occurs with passage of time in the majority except those with vascular injury.[67]

Follow up information on renal trauma patients is usually limited. Few papers have any long term outcome data. This is likely a reflection that the patients often reside many miles from the trauma center where they were managed. It could also be related to the patient demographic being younger, active subjects.

MATERIALS AND METHODS

SOURCE OF DATA:

This prospective study was conducted in Department of Urology & kidney Transplant, Dayanand Medical College & Hospital.

METHOD OF COLLECTION OF DATA

Inclusion Criteria

- Patients of age group above 13 years presenting with renal injury in blunt trauma abdomen
- Associated injuries
- Either gender

Exclusion Criteria

- Age <13 years
- Penetrating injury
- Iatrogenic injury
- Patients who died within 6 hours after reaching emergency

Demographic profile of all the patients was noted down. The date and time of injury along with date and time of hospital arrival were noted. A note of associated injuries was made. Renal injury was graded according to the American Association of Surgery in Trauma (AAST):

Grade I: contusion or non-enlarging subcapsular perirenal hematoma, and no laceration

Grade II: superficial laceration <1 cm depth and does not involve the collecting system (no evidence of urine extravasation), non-expanding perirenal hematoma confined to retroperitoneum

Grade III: laceration >1 cm without extension into the renal pelvis or collecting system (no evidence of urine extravasation)

Grade IV

- laceration extends to renal pelvis or urinary extravasation
- vascular: injury to main renal artery or vein with contained hemorrhage

- segmental infarctions without associated lacerations
- expanding subcapsular haematomas compressing the kidney

Grade V

- shattered kidney
- avulsion of renal hilum: devascularisation of a kidney due to hilar injury
- ureteropelvic avulsions
- complete laceration or thrombus of the main renal artery or vein

A note of vitals at the time of arrival to our hospital was made. Number of blood products transfused was noted. Patients were kept under monitoring throughout the first week and daily Heart rate, blood pressure, hemoglobin and urine output was charted. DMSA scan was performed in first 7 days. A note of any surgical intervention or angioembolization along with the procedure details was done. Complications and their management during the hospital stay were noted. On follow up after 3 months, patient was examined clinically along with serum creatinine levels and a DMSA/USG scan.

Parameters Studied

Following evaluation was done in all the patients-

1. Grade of injuries according to AAST and their management whether managed conservatively or by angioembolization or surgical procedure.
2. Complications (Urosepsis, Urinoma, Peri-renal abscess, renal failure).
3. Management of complications (I/V antibiotics, Nephrectomy, Dialysis, Ureteral stent, percutaneous drainage)
4. Assessment of early and delayed relative function of injured kidney with the help of DMSA renal scan within 7 days and second DMSA scan/USG, 3 months after trauma

Statistical Analysis

Data was described in the terms of range, mean±standard deviation, median, frequency (number of cases) and relative frequencies (percentage) as appropriate.

OBSERVATION & RESULTS

This prospective study was conducted in Department of Urology & kidney Transplant, Dayanand Medical College & Hospital, Ludhiana. All 18 patients were included who had blunt renal injury during the 18 months period of study.

Table 1: Age distribution

Age (years)	No. of cases	Percentage
<20	6	33.3%
21-30	5	27.8%
31-40	3	16.7%
>40	4	22.2%
Total	18	100%

In our study, the mean age was 26.72±11.89 years. Only patients above 13 years of age were included in the study. Minimum age was 16 years while maximum age was 55 years in our study.

Figure 1: Age distribution

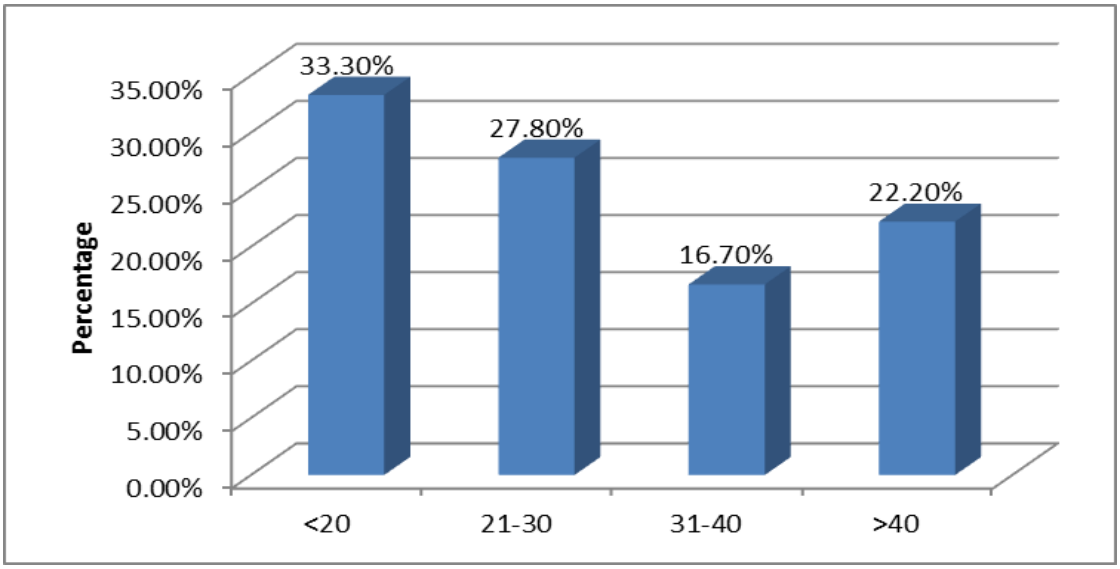


Table 2: Gender distribution

Gender	No. of cases	Percentage
Male	15	83.3%
Female	3	16.7%
Total	18	100%

In our study majority of the patients were male i.e. 15 out of 18 (83.3%).

Figure 2: Gender distribution

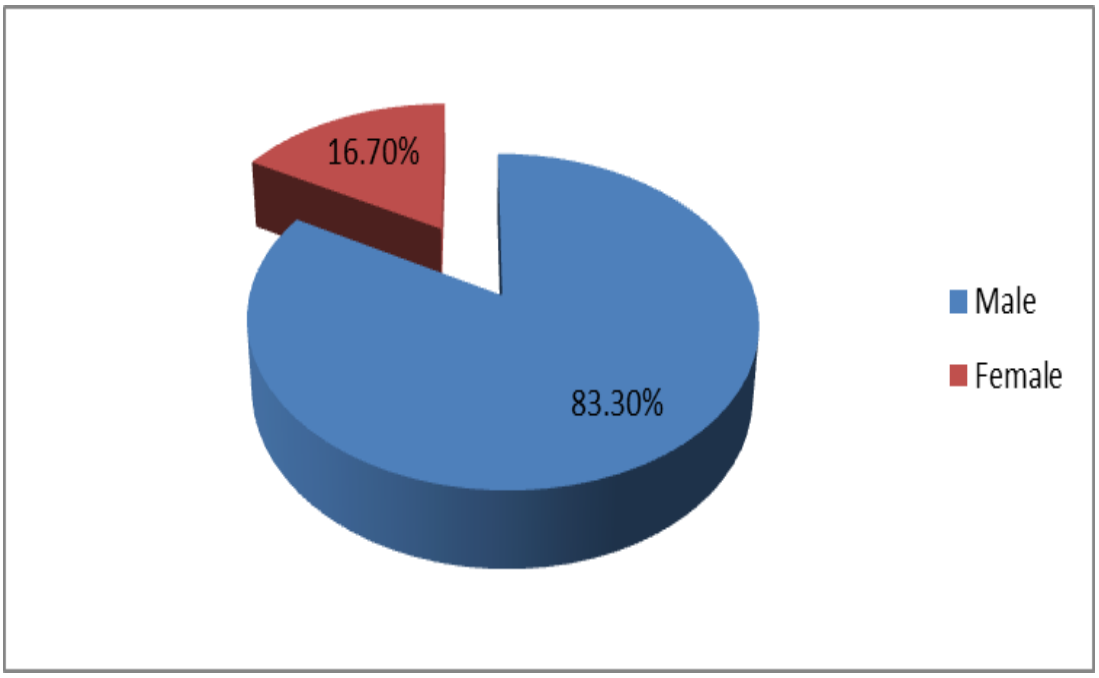


Table 3: Mode of injury

Mode of injury	No. of cases	Percentage
Motor vehicle accidents	13	72.2%
Fall	4	22.2%
Assaults	1	5.6%
Sports	0	0
Pedestrian	0	0
Total	18	100%

Most common mode of injury leading to renal injuries were motor vehicle accidents i.e. 13 cases out of 18 (72.2%) followed by fall from height i.e. 4 (22.2%) and one case (5.6%) of physical assault. We had no cases of sports injury or pedestrian accidents leading to renal injury.

Figure 3: Mode of injury

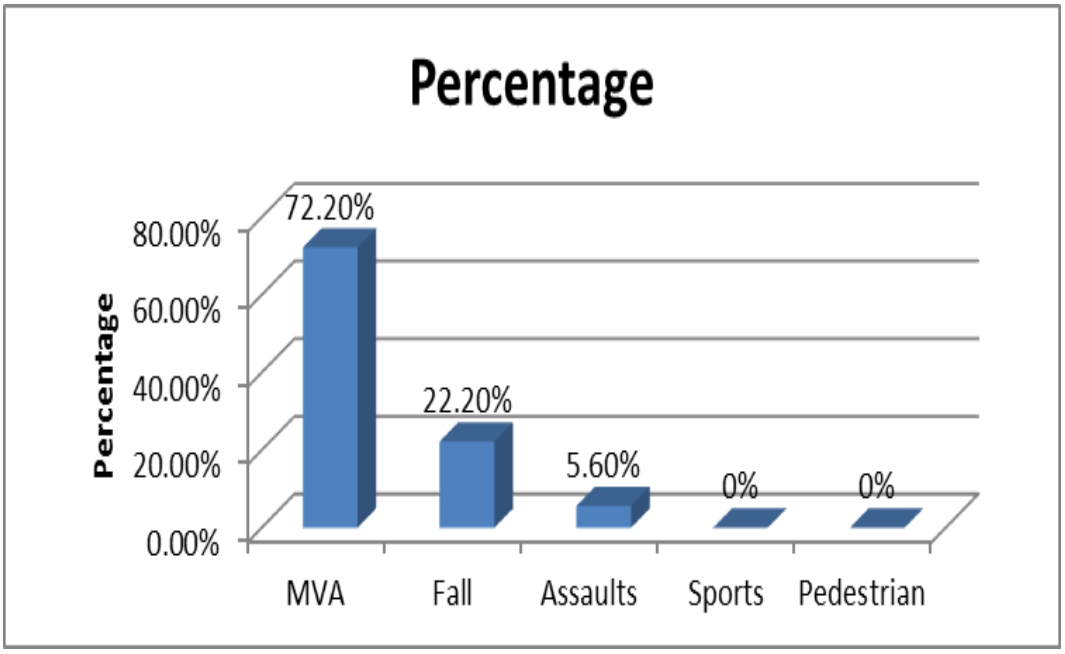


Table 4: Associated injury

	Number of cases (n=18)	Percentage
Liver	11	61.0%
Spleen	4	22.0%
Pancreas	1	05.5%
Rib fracture	3	16.5%
Head injury	2	11.0%
Flail chest	1	05.5%
Lung injury	1	05.5%
Pelvic fracture	2	11.0%

Most common associated organ injured in renal trauma was Liver i.e. 11 out of 18 cases (61%). Second most common was spleen in 4 cases (22%). Three cases (16.5%) had rib fractures along with renal trauma. Two cases (11%) each of head injury and pelvic fractures were recorded. Pancreatic injury, lung injury and flail chest were present in one case (5.5%) each.

Figure 4: Associated injury

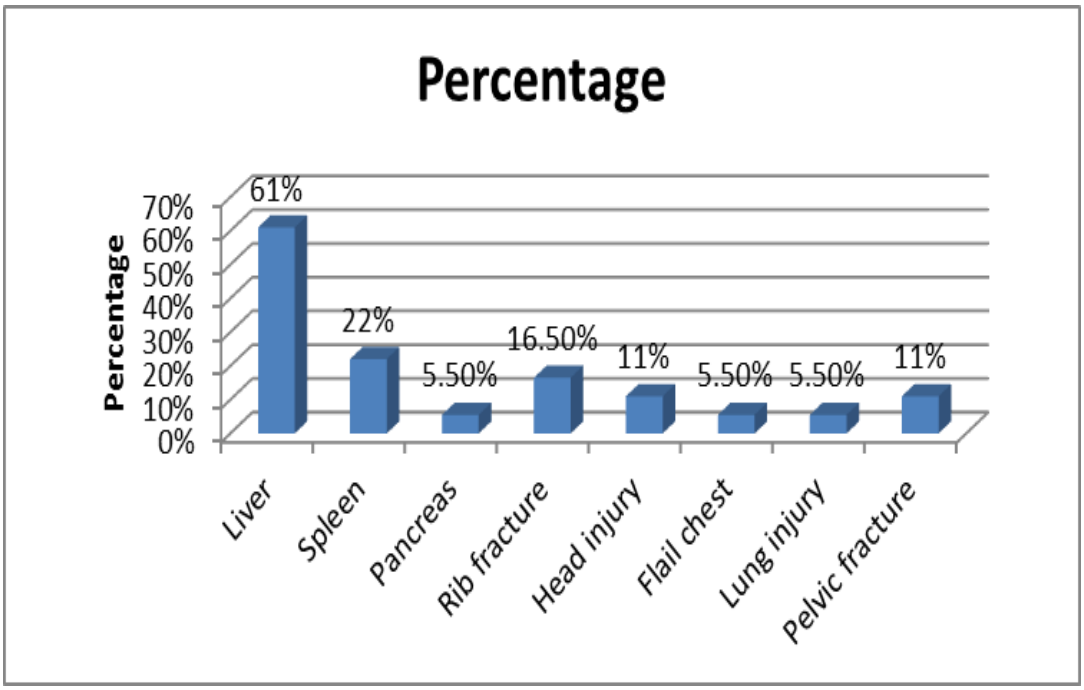


Table 5: Duration of hospital stay

Hospital Stay (Days)	Number of cases (n=18)	Percentage
<10	11	61.11%
11-15	5	27.77%
>15	2	11.11%

In our study, mean hospital stay was 10.27±3.75 days. One patient expired due to associated injuries on day 2 of hospital admission. Most of the patients i.e. 11 out of 17 (61.11%) had hospital stay less than 10 days. Two patients (11.11%) stayed for more than 15 days due to the complications of renal trauma and interventions done to treat them. Minimum hospital stay was 2 days and maximum hospital stay was 16 days.

Figure 5: Duration of hospital stay

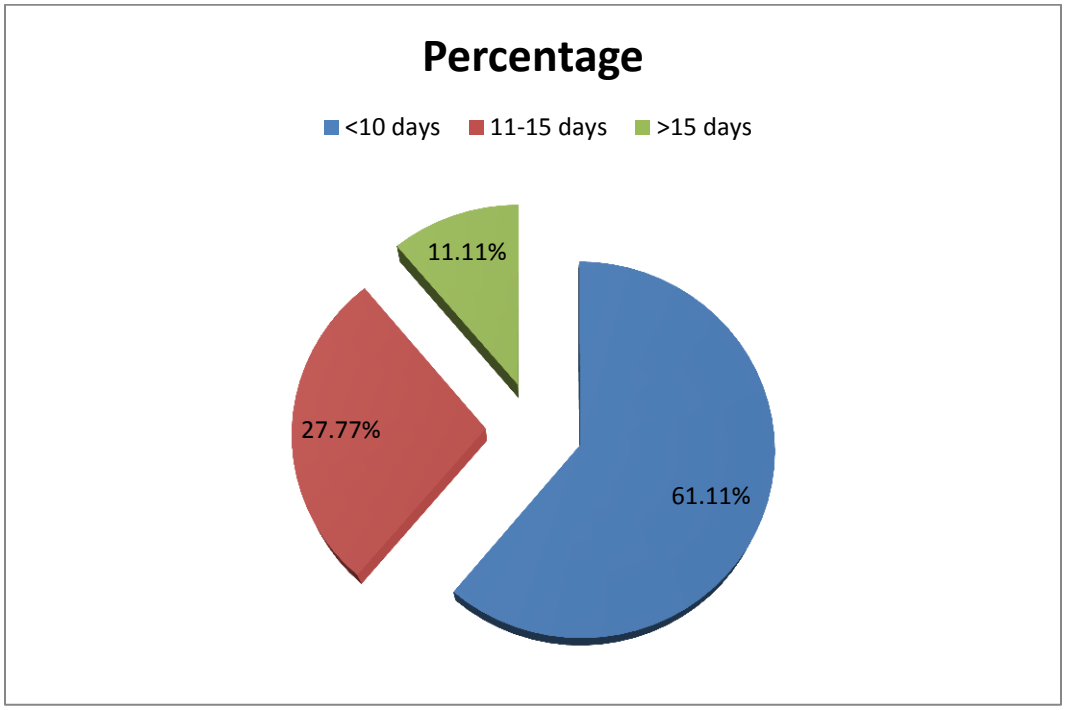


Table 6: Side of renal injury

Side of injury	Number of cases	Percentage
Left	8	44.4%
Right	10	55.6%
Total	18	100%

Out of 18 patients, 10 (55.6%) had right kidney injury while 8 (44.4%) had left kidney injury. There was no bilateral renal injury. Splenic injuries were associated with left side renal trauma in 4 out of 8 patients (50%). Right renal injuries were associated with liver injuries in 8 out of 10 patients (80%).

Figure 6: Side of renal injury

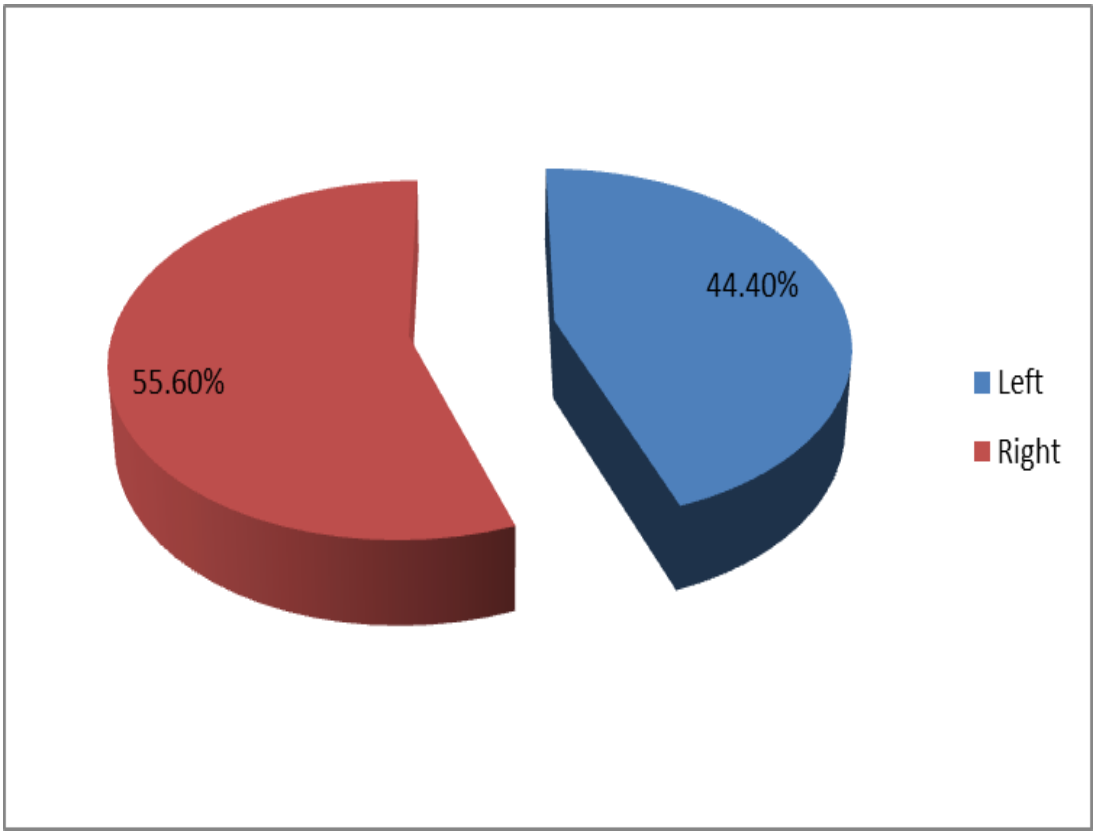


Table 7: Frequency of hematuria

Hematuria	Number of cases	Percentage
Yes	10	55.6%
No	8	44.4%
Total	18	100%

Hematuria was found to occur in 10 cases out of 18 i.e. 55.6%.

Figure 7: Frequency of hematuria

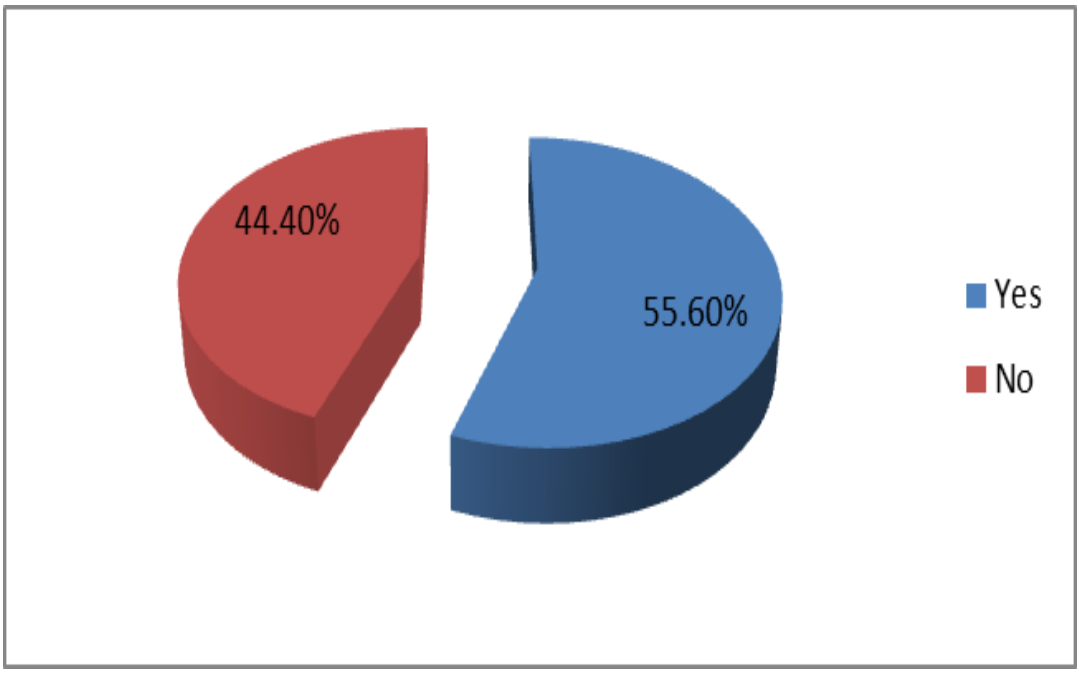


Table 8: Grade of renal injury

	Number of cases	Percentage
Grade I	3	16.7%
Grade II	3	16.7%
Grade III	3	16.7%
Grade IV	6	33.3%
Grade V	3	16.7%
Total	18	100%

There were 3 patients (16.7%) each of Grade I, Grade II, Grade III and Grade V renal injury. Grade IV renal injury was more common accounting for 6 cases out of 18 (33.3%).

Figure 8: Grade of renal injury

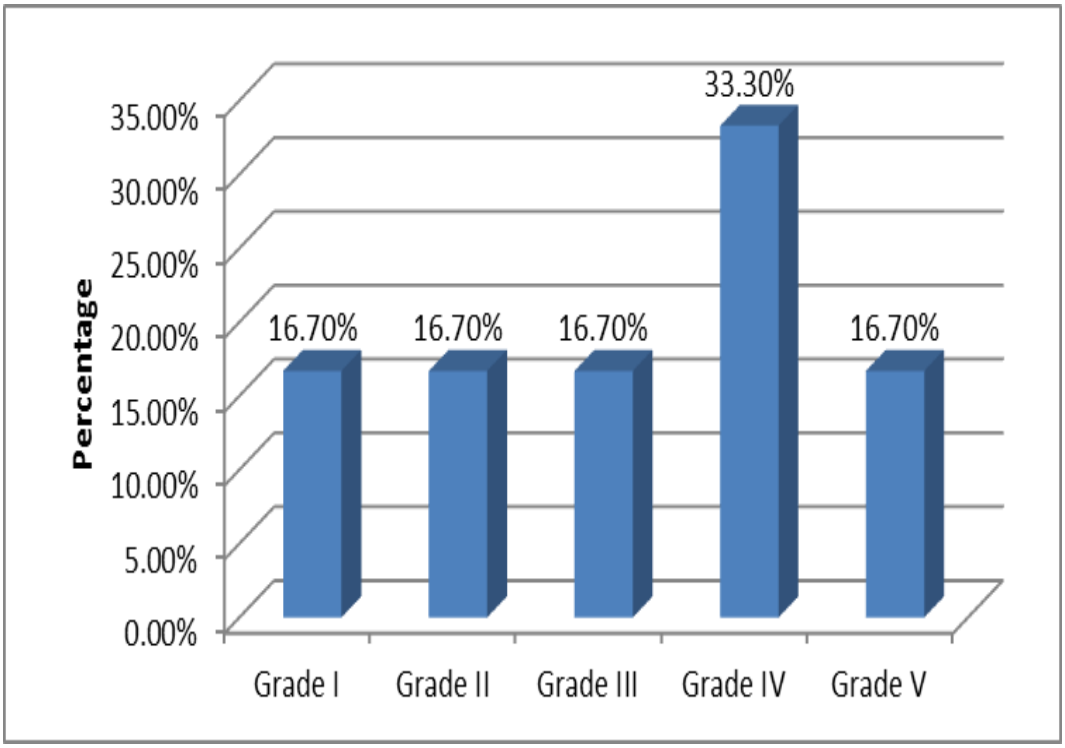


Table 9: Relationship of Grade of renal injury with hematuria

Grade of renal injury	Hematuria		Total
	Yes	No	
Grade I	0	3	3
Grade II	3	0	3
Grade III	2	1	3
Grade IV	3	3	6
Grade V	2	1	3

None of the patient belonging to Grade I renal injury had hematuria. All three patients of Grade II injury had hematuria. Two out of 3 patients from Grade III and Grade V each had hematuria. Three out of 6 patients of Grade IV had hematuria.

Figure 9: Relationship of Grade of renal injury with hematuria

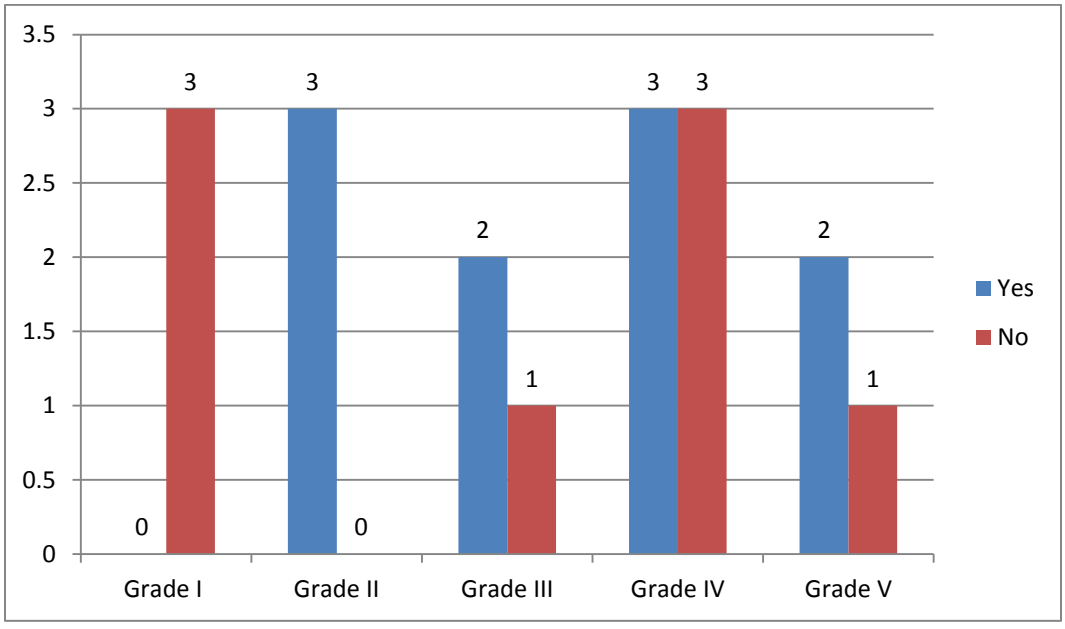


Table 10: Management of renal injury according to Grade

	Conservative	Surgery	Angioembolization	Total
Grade I	3	0	0	3
Grade II	3	0	0	3
Grade III	3	0	0	3
Grade IV	5	0	1	6
Grade V	1	1	1	3
TOTAL	15 (83.33%)	1 (5.5%)	2 (11.11%)	18

All Patient of Grade I, II and III renal injury were managed conservatively by bed rest with close monitoring, regular clinical examination, resuscitation with intravenous fluids, blood transfusion and twice daily checks for decreases in hematocrit and renal function.

Although one patient of Grade I renal trauma underwent laparotomy for grade V splenic injury. One patient of Grade I renal injury expired on day 2 of hospital admission after he underwent laparotomy. He also had Grade V splenic injury, grade III liver injury, flail chest, lung injury and head injury. His death was due to associated injuries rather than the renal injury.

Out of 6 patients of Grade IV renal trauma, 5 were managed conservatively and one patient underwent angioembolization of main renal artery in view of active contrast leak and active bleeding.

Out of 3 patients of Grade V renal trauma, one was managed conservatively, one patient had to be explored and nephrectomy along

with splenectomy was done and one patient underwent angioembolization of the main renal artery owing to increasing size of peri-renal hematoma.

In total, 15 out of 18 patients i.e. 83.33% were managed conservatively in our study.

Figure 10: Management of renal injury according to Grade

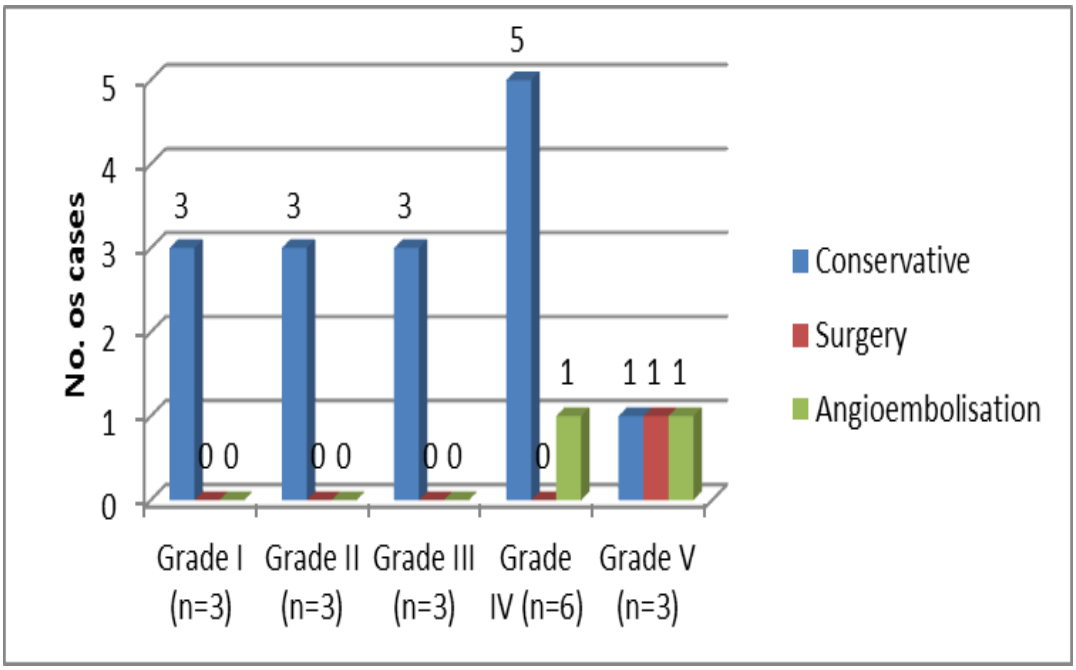


Table 11: Urological complications by grade

Complication	Grade I (n=3)	Grade II (n=3)	Grade III (n=3)	Grade IV (n=6)	Grade V (n=3)
Perinephric abscess	0	0	0	1	1
Urinoma formation	0	0	0	2	0
Delayed hemorrhage	0	0	0	0	0
Hypertension	0	0	0	0	0

Four out of 18 patients had urological complications. None of the patients belonging to Grade I, II and III renal injury group had any urological complications. Three patients of Grade IV renal injury had complications out of which one patient had perinephric abscess formations and 2 patients had urinoma formation. One patient in Grade V group had perinephric abscess formation with fever. None of the patient in any group had delayed hemorrhage or hypertension during the 3 month follow up.

Figure 11: Urological complications by grade

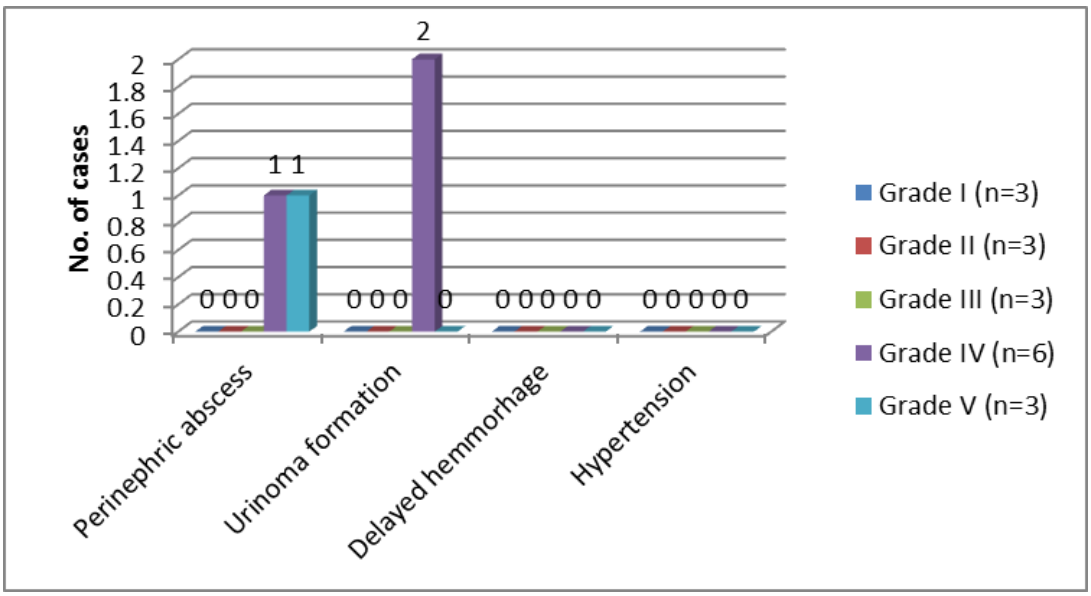


Table 12: Management of complications

Complication	Number of cases	Management
Perinephric abscess	2	1st case-PCD insertion 2nd case- I/V antibiotics
Urinoma formation	2	DJ stenting

One patient of perinephric abscess was treated with PCD insertion and appropriate antibiotics. The other one was treated with I/V antibiotics only. Patient who had PCD insertion got discharged after 14 days and th one managed with antibiotics only was discharged after 16 days.

Both the cases of urinoma formation were treated with DJ stenting and they recovered well. They were discharged after 14 and 16 days.

Table 13: DMSA Scan Differential function of injured kidney within 7 days and after 3 months

DMSA Scan	Mean Differential function of injured kidney
Within 7 days	33.25 ± 15.33
After 3 months	37.92 ± 15.07
p value	0.002

Twelve patients out of 18 could complete this study with respect to DMSA scans (both early and late DMSA scans). Six patients could not complete the study as two of them underwent embolization, two refused for the scans, one underwent nephrectomy and one expired.

Mean early function of injured kidney was 33.25% and mean late function was 37.92%. The difference was found to be statistically significant (p=0.002) using paired t-test. So there was improvement in renal function with passage of time.

Figure 12: DMSA Scan Differential function of injured kidney within 7 days and after 3 months

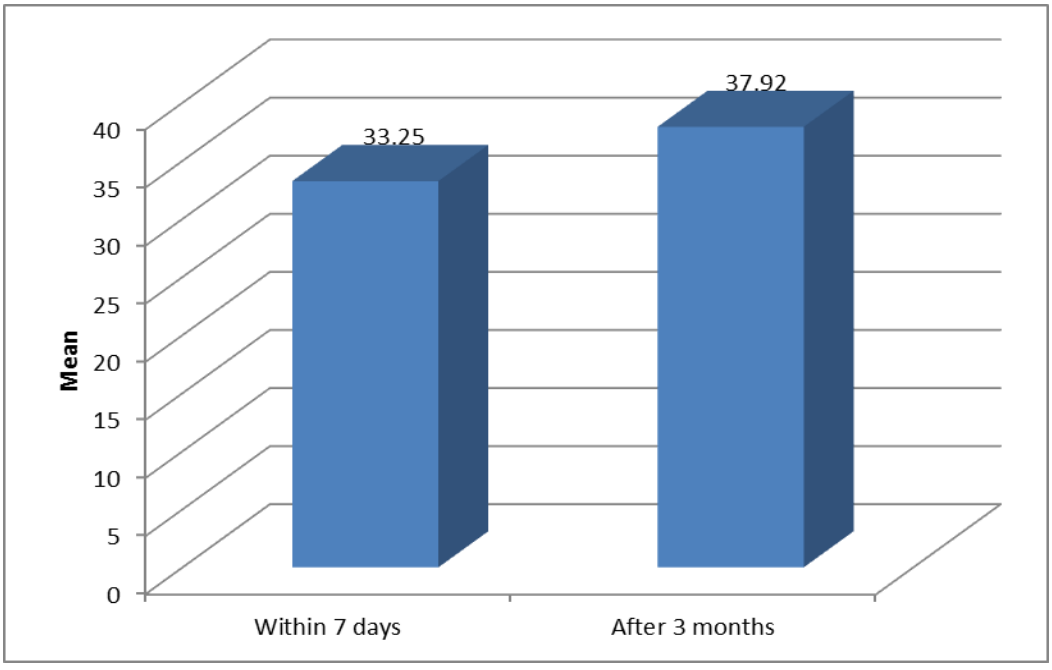


Table 14: DMSA Scan Differential function of injured kidney in low grade renal injury and high grade renal injury within 7 days and after 3 months

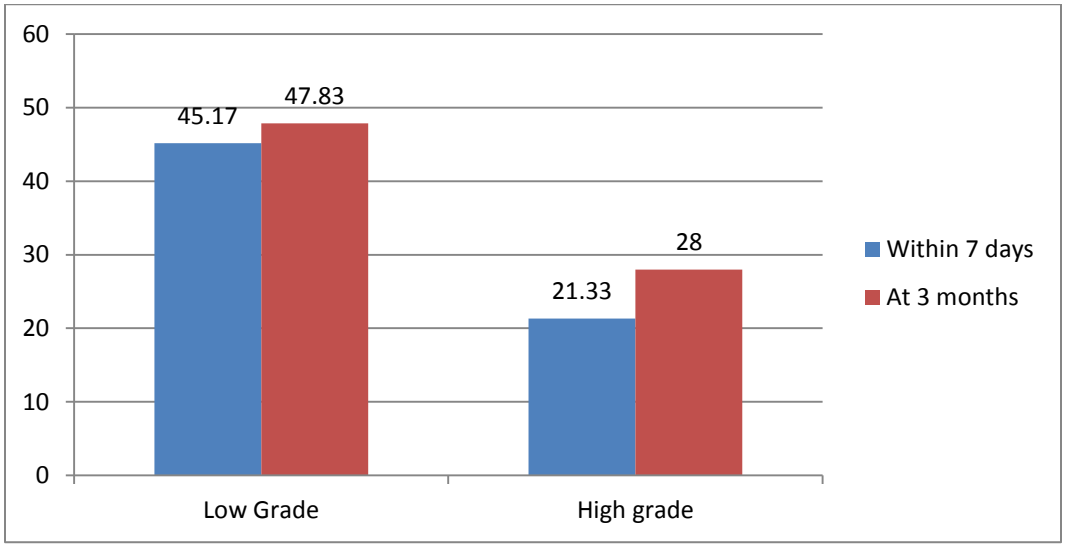
Grade I, II and III renal injury were collectively classified as low grade injuries in which the consensus is conservative management. Six patients fulfilled the criteria for low grade and high grade injury each.

Mean early function of injured kidney in low grade renal injury was 45.17% and mean late function was 47.83%. The difference was found to be statistically significant (p=0.038) using paired t-test.

Mean early function of injured kidney in high grade renal injury was 21.33% and mean late function was 28.00%. The difference was found to be statistically significant (p=0.017) using paired t-test.

DMSA Scan	Mean Differential function of injured kidney in Low grade (n=6)	Mean Differential function of injured kidney in High grade (n=6)
Within 7 days	45.17±3.19	21.33±12.88
After 3 months	47.83±2.40	28.00±16.05
p value	0.038	0.017

Figure 13: DMSA Scan Differential function of injured kidney in low grade and high grade renal injury within 7 days and after 3 months



DISCUSSION

This prospective study was conducted in Department of Urology & kidney Transplant, Dayanand Medical College & Hospital, Ludhiana to study the pattern of renal injury in blunt trauma abdomen, its management and outcome with respect to renal functions at our institute.

AGE

In our study, the mean age was 26.72 years. Only patients above 13 years of age were included in the study. Minimum age was 16 while maximum age was 55 in our study.

	Mean age
Our study	**26.72±11.89 years**
Patel et al 2014	22.76±11.6 years
Iqbal et al 2004	29±12.1years
Min A Lee et al 2017	39.7±14.1 years

Patel et al in 2014 conducted an Observational Cross Sectional Combined Retrospective and Prospective study of 25 patients of blunt renal injuries and found out maximum incidence of blunt renal trauma was seen in the age group of 11-20 years of age (Mean age-22.76 years).[17]

In another study of 65 patients in 2004, **Iqbal et al** found out mean age of the 65 patients was 29+12.1 years ranging from 18 to 65 years.[18] **Min A Lee et al** also found out mean age to be 39.7 years.[65]

This is probably because patient in this age group lead more active life and have more outdoor activities

GENDER

In our study majority of the patients were male i.e. 15 out of 18 (83.3%).

	Male	Female
Our study	**15 (83%)**	**3 (17%)**
Mangaiyarkarasi et al 2017	32 (84%)	6 (16%)
Patel et al 2014	23 (92%)	2 (8%)
Iqbal et al 2004	59 (90%)	6 (10%)
Aragona et al 2011	37 (82%)	8 (18%)

In a study by **Mangaiyarkarasi et al** in 2017, of the total of 38 patients who sustained renal injuries, 84% (32 out of 38) were males. Only 6 females (16%) sustained renal injuries in their series.[22] In 2014, **Patel et al** found out 92% of patients with renal injury to be male.[17] **Iqbal et** al found 59 out of 65 patients to be male.[18]

The incidence of abdominal trauma in male population is higher because in our country males are the bread earners of the family so. They are more commonly travelling and are at higher changes of getting injured in accidents.

MODE OF INJURY

Most common mode of injury leading to renal injuries were motor vehicle accidents i.e. 13 cases out of 18 (72.2%) followed by fall from height i.e. 4 (22.2%) and one case (5.6%) of physical assault. We had no cases of sports injury or pedestrian accidents leading to renal injury.

	Our study	Voelzke and Leddy 2014	Aragona et al 2011	Iqbal et al 2004
MVA	72.2%	63%	84%	69%
Fall	22.2%	22%	14%	21%
Sports	0	11%	2%	6%
Pedestrian	0	4%	0	2%
Assaults	5.6%	0	0	2%

In a systematic review conducted by **Voelzke and Leddy**, blunt renal trauma in the adult population was caused primarily by motor vehicle accidents (MVAs) (63%), followed by falls (22%), sports (11%) and pedestrian accidents (4%).[20] In a study in 2011 by **Aragona et al**, out of 45, motor vehicle accidents accounted for 38 injuries (84%), falls for six (14%) and a sports accident for one case.[19] **Iqbal et al** found forty five (69%) were involved in motor vehicle accidents.[18]

ASSOCIATED INJURY

Most common associated organ injured in renal trauma was Liver i.e. 11 out of 18 cases (61%). Second most common was spleen in 4 cases (22%). Three cases (16.5%) had rib fractures along with renal trauma. Two cases (11%) each of head injury and pelvic fractures were noted. Pancreatic injury, lung injury and flail chest were present in one case (5.5%) each.

	Our Study	**Patel et al 2014**
Liver	61%	32%
Spleen	22%	32%
Pancreas	5.5%	0 %
Rib fracture	16.5%	56%
Flail chest	5.5%	
Lung injury	5.5%	
Pelvic fracture	11%	20%
Head injury	11%	28%

In 2014, **Patel et al** demonstrated lesions associated with other organs in over 70% of patients. Out of 25 patients of blunt renal injury all underwent CECT abdomen, of them splenic injury was detected in (32%) patients and liver injury was also detected in (32%) patients. Chest injury was associated in (56%) of the patients, of them most common was rib fractures.[17]

HOSPITAL STAY

In our study, mean hospital stay was 10.27±3.75 days. One patient expired due to associated injuries on day 2 of hospital admission. Most of the patients i.e. 11 out of 17 (61.11%) had hospital stay less than 10 days. Two patients (11.11%) stayed for more than 15 days due to the complications of renal trauma and interventions done to treat them. Minimum hospital stay was 2 days and maximum hospital stay was 16 days.

	Average Hospital stay
Our study	**10.27±3.75 days**
Garcia et al 2009	8 days
Moudouni et al 2001	16.3 days
Patel et al 2014	11.34 days

Garcia et al [38] in their study have shown that the average stay in hospital was 8 days while in the study by **Moudouni et al** [39] the mean hospital stay was 16.3 days. **Patel et al** demonstrated mean hospital stay for the conservative group patients was 11.34 days.[17]

The period of hospital stay may not be comparable as social customs, free medicare, literacy of the population, financial capability and availability of transport may determine the mean hospital stay over and above the actual clinical condition.

SIDE OF RENAL INJURY

Out of 18 patients, 10 (55.6%) had right kidney injury while 8 (44.4%) had left kidney injury. Splenic injuries were associated with left side renal trauma in 4 out of 8 patients (50%). Right renal injuries were associated with liver injuries in 8 out of 10 patients (80%).

	Left	**Right**
Our study	**8 (44%)**	**10 (56%)**
Aragona et al 2011	26 (58%)	19 (42%)
Min A Lee et al 2017	27 (44%)	35 (56%)

In a study in 2011 by **Aragona et al**, out of 45 patients, 26 (58%) had left side and 19 (42%) had right side renal injury. Min A Lee et al had similar findings to our study.

HEMATURIA

Hematuria was found to occur in 10 cases out of 18 i.e. 55.6%. None of the patient belonging to Grade I renal injury had hematuria. All three patients of Grade II injury had hematuria. Two out of 3 patients from Grade III and Grade V each had hematuria. Three out of 6 patients of Grade IV had hematuria.

	Hematuria
Our study	**10 (55%)**
Patel et al 2014	16 (64%)
Herschorn et al 1991	34 (68%)
Iqbal et al 2004	40 (61%)
Aragona et al 2011	35 (77%)

Hematuria associated with renal trauma is not a predictable indicator of grade of renal injury. The degree of hematuria does not correlate with the severity of injury. Mild injuries including simple hematomas can produce gross hematuria.

Hematuria was present in (64%) of the patients in the study by **Patel et al**.[17] In a study by **Herschorn et al** in 1991, 68% of patients of renal trauma had hematuria.[28]

GRADE OF INJURY

There were 3 patients (16.7%) each of Grade I, Grade II, Grade III and Grade V renal injury. Grade IV renal injury was more common accounting for 6 cases out of 18 (33.3%).

	Our study (n=18)	Iqbal et al (n=65)	Aragona et al (n=70)
Grade I	**3 (16.7%)**	18 (27%)	15 (21%)
Grade II	**3 (16.7%)**	09 (14%)	10 (14%)
Grade III	**3 (16.7%)**	13 (20%)	21 (30%)
Grade IV	**6 (33.3%)**	16 (24%)	18 (25%)
Grade V	**3 (16.7%)**	09 (14%)	6 (8%)

MANAGEMENT OF RENAL INJURY ACCORDING TO GRADE

All Patient of Grade I, II and III renal injury were managed conservatively by bedrest with close monitoring, regular clinical examination, resuscitation with intravenous fluids, blood transfusion and twice daily checks for decreases in hematocrit and renal function.

Although, one patient of Grade I renal trauma underwent laparotomy for grade V splenic injury. One patient of Grade I injury expired on day 2 of hospital admission after he underwent laparotomy and had Grade V splenic injury, grade III liver injury, Flail chest, lung injury and head injury. . His death was due to associated injuries rather than the renal injury.

In a study by Buckley et al in 2011, the nephrectomy rate in Grade III injury was very low (1.8%) in another study (3/171).[47] Aragona and colleagues found that among 21 patients with grade III blunt renal trauma the nephrectomy rate was 9% but when it was divided into two periods (2001–5, 2006–10) it was found that during the second period there were no nephrectomies. This is attributed to the growing use of angioembolization.[19]

Out of 6 patients of Grade IV renal trauma, 5 were managed conservatively and one patient underwent angioembolization of main renal artery in view of active contrast leak and active bleeding. Hammer et al in their study found out nephrectomy rate for Grade IV to be 0%.[26] Most grade IV blunt renal injuries were treated nonoperatively, with a low

incidence of nephrectomy in a study by Santucci RA et al, as they reported that in 57 patients had Grade IV renal injuries, 84.2% were managed conservatively, while the remaining 15.8% of them underwent renal exploration.[48]

Out of 3 patients of Grade V renal trauma, one was managed conservatively, one patient had to be explored and nephrectomy along with splenectomy was done and one patient underwent angioembolization of the main renal artery owing to increasing size of peri-renal hematoma. Sahai et al determined the feasibility of a non-operative approach to blunt grade V renal injury and found that conservative management is feasible in patients who are hemodynamically stable at presentation.[42] In a retrospective review of 13 patients by Altmen et al in 2000 with Grade V blunt renal injury, six hemodynamically stable patients with a shattered but perfused kidney were successfully treated nonoperatively.[33] Seven patients with either a nonperfused kidney or hemodynamic instability were treated operatively. The nonoperative group had fewer ICU days, significantly lower transfusion requirements, and fewer complications. A follow-up CT scan of nonoperatively treated patients revealed a functioning kidney in four of the six patients in which it was performed.

In total, 15 out of 18 patients i.e. 83.33% were managed conservatively in our study. Matthews et al in 1997, did a retrospective study comprising of 126 patients with blunt renal injury in which 90% patients were treated conservatively. Overall, results were excellent in 87%; there were four deaths unrelated to the renal injury and two patients who required dialysis.[43]

UROLOGICAL COMPLICATIONS BY GRADE AND THEIR MANAGEMENT

None of the patients belonging to Grade I, II and III renal injury group had any urological complications. Three patients of Grade IV renal injury had complications out of which one patient had perinephric abscess formations and 2 patients had urinoma formation. One patient in Grade V

group had perinephric abscess formation with fever. None of the patient in any group had delayed hemorrhage or hypertension during the 3 month follow up. Both the cases of urinoma formation were treated with DJ stenting and they recovered well. They were discharged after 14 and 16 days. One patient of perinephric abscess was treated with PCD insertion and appropriate antibiotics. The other one was treated with I/V antibiotics alone. Patient who had PCD insertion got discharged after 14 days and who was managed with antibiotics was discharged after 16 days.

In 2017, Min A Lee et al in their study of 62 renal injury patients found out 13 patients had complications (20%): four patients had urine leakage (6.5%); three had delayed bleeding (4.8%); two had hydronephrosis (3.2%); two had pseudoaneurysm (3.2%); one patient had an abscess; and one had renal failure. The Incidence of urological complications correlated with increasing grade (grade III=8.3%, grade IV=22.6%, and grade V=57.1%; p=0.021).[65] In a study in 2011 by Aragona et al, Among 18 grade 4 renal injury patients, five needed ureteral stenting and in one case a percutaneous drainage of a perinephric abscess was needed.[19] Robert et al in his study showed pyelonephritis (9%), residual perinephric fluid collection (36%) and ureteral stenting for urinary extravasation in 36% cases.[57] Alsikafi et al reported 9% patients with major blunt injury and urinary extravasation required ureteric stenting for persistent extravasation, while 91% had spontaneous resolution.[59]

DMSA SCAN DIFFERENTIAL FUNCTION OF INJURED KIDNEY WITHIN 7 DAYS AND AFTER 3 MONTHS

Twelve patients out of 18 could complete this study with respect to DMSA scans (both early and late DMSA scans). Mean early function of injured kidney was 33.25% and mean late function was 37.92%. The difference was found to be statistically significant (p=0.002) using paired t-test. So there was improvement in renal function with passage of time.

DMSA Scan	Our study	Kumar K et al 2017
Within 7 days	33.25 ± 15.33	35.7%
After 3 months	37.92 ± 15.07	39.6%
p value	0.002	0.001

Grade I, II and III renal injury were collectively classified as low grade injuries in which the consensus is conservative management. Six patients fulfilled the criteria for low grade and high grade injury each. Mean early function of injured kidney in low grade renal injury was 45.17% and mean late function was 47.83%. The difference was found to be statistically significant (p=0.038) using paired t-test. Mean early function of injured kidney in high grade renal injury was 21.33% and mean late function was 28.00%. The difference was found to be statistically significant (p=0.017) using paired t-test. The increase in our study was more significant in high grade as compared to low grade renal injuries

In 2017, Kumar K et al did a prospective study to compare renal function with DMSA scan within 7 days and 3 months after trauma for assessment of early and delayed relative function of injured kidney respectively. Total 32 patients fulfilled the inclusion and exclusion criteria and completed the study. They found out that the mean early relative function of the injured kidney (35.7%) improved significantly at 3 months (39.6%) ($p < 0.001$). When they considered Grade I to Grade III as low grade they observed a significant improvement in differential renal functions (from 46.1±3.2% to 50.4±2.7%, $p<0.01$). In high grade renal injury (Grade IV and Grade V) there was also improvement in functions except grade V injury (from 43.0±6.21% to 48.7±3.3%, $p<0.042$)) They concluded that the improvement of function of injured kidney occurs with passage of time in the majority except those with vascular injury.[67]

Follow up information on renal trauma patients is usually limited. There is very little data with long term outcome. Our results on increase in

differential function over time matches the conclusion by Kumar et al in 2017 except that the increase in our study was more significant in high grade as compared to low grade renal injuries. But as our study had a few number of cases due to time constraint, there is a need for a study of longer duration with more centers to collaborate observations in our study.

SUMMARY & CONCLUSION

This prospective study was conducted in Department of Urology & kidney Transplant, Dayanand Medical College & Hospital, Ludhiana. A total of 18 patients were enrolled who had blunt renal injury.

1. **AGE:** In our study, the mean age was 26.72 years. Only patients above 13 years of age were included in the study. Minimum age was 16 while maximum age was 55 in our study.
2. **SEX:** In our study majority of the patients were male i.e. 15 out of 18 (83.3%).
3. **MODE OF INJURY:** Most common mode of injury leading to renal injuries were motor vehicle accidents i.e. 13 cases out of 18 (72.2%) followed by fall from height i.e. 4 (22.2%) and one case (5.6%) of physical assault.
4. **ASSOCIATED INJURY**: Most common associated organ injured in renal trauma was Liver i.e. 11 out of 18 cases (61%). Second most common was spleen in 4 cases (22%). Three cases (16.5%) had rib fractures along with renal trauma. Two cases (11%) each of head injury and pelvic fractures were noted. Pancreatic, Lung and Flail chest were present in one case (5.5%) each.
5. **DURATION OF HOSPITAL STAY:** In our study, mean hospital stay was 10.76 days. Most of the patients i.e. 11 out of 17 (61.11%) had hospital stay less than 10 days
6. **SIDE OF RENAL INJURY:** Out of 18 patients, 10 (55.6%) had right kidney injury while 8 (44.4%) had left kidney injury.
7. **FREQUENCY OF HEMATURIA:** Hematuria was found to occur in 10 cases out of 18 i.e. 55.6%. The degree of hematuria does not correlate with the severity of injury. Mild injuries including simple hematomas can produce gross hematuria.
8. **GRADE OF RENAL INJURY:** Grade IV renal injury was more common accounting for 6 cases out of 18 (33.3%).

9. **MANAGEMENT OF RENAL INJURY:** All Patient of Grade I, II and III renal injury were managed conservatively. Out of 6 patients of Grade IV renal trauma, 5 were managed conservatively and one patient underwent angioembolization. Out of 3 patients of Grade V renal trauma, one was managed conservatively, one patient had to be explored and nephrectomy along with splenectomy was done and one patient underwent angioembolization. In total, 15 out of 18 patients i.e. 83.33% were managed conservatively in our study.
10. **UROLOGICAL COMPLICATIONS:** Three patients of Grade IV renal injury had complications out of which one patient had perinephric abscess formations and 2 patients had urinoma formation. One patient in Grade V group had perinephric abscess formation with fever.
11. **MANAGEMENT OF COMPLICATIONS:** Both the cases of urinoma formation were treated with DJ stenting and they recovered well. One patient of perinephric abscess was treated with PCD insertion with appropriate antibiotics and the other one treated with I/V antibiotics alone.
12. **DMSA SCAN DIFFERENTIAL FUNCTION OF INJURED KIDNEY WITHIN 7 DAYS AND AFTER 3 MONTHS:** Mean early function of injured kidney was 33.25% and mean late function was 37.92%. So we can conclude that there is improvement of function of injured kidney with passage of time in the majority of the patients. Mean early function of injured kidney in low grade renal injury was 45.17% and mean late function was 47.83%. The difference was found to be statistically significant (p=0.038) using paired t-test. Mean early function of injured kidney in high grade renal injury was 21.33% and mean late function was 28.00%. The difference was found to be statistically significant (p=0.017) using paired t-test. The increase in our study was more significant in high grade as compared to low grade renal injuries.

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Sr. No	Name	Age	Sex	MRD no.	BMI	DOI	TOI	DOA	TOA	DOD	MOI	ICU Stay	Hospital stay	Side of renal injury	Grade of renal injury	Gross Hematuria	Associated injury
1	JR	17 yrs	M	445174	19.5	23/2/18	6:00 PM	23/2/18	8:00 PM	03-03-2018	MVA	5 days	10	Right	4	yes	Liver grade 1
2	R	35 yrs	M	452912	22	03-06-2018	5:00 PM	03-06-2018	6:45 PM	21/3/18	MVA	8 days	15	left	5	yes	panc 3 spleen 2
3	RK	27 yrs	F	497758	22.5	13/5/2018	6:30 PM	13/5/18	7:52 PM	27/5/18	MVA	10 days	14	left	5	no	spleen 5, rib fracture
4	PR	44 yrs	F	540013	26	16/7/2018	6:15 PM	16/7/18	10:00 PM	24/7/18	Fall from height	5 days	8	right	1	no	liver 2
5	MW	18 yrs	M	549922	19	30/7/2018	10:30 PM	31/7/18	4:00 AM	08-11-2018	MVA	5 days	10	right	3	yes	liver 4, rib fracture
6	KD	55 yrs	F	578103	22	09-09-2018	9:30 PM	09-09-2018	11:30 PM	18/9/18	Fall from	2 days	9	RIGHT	1	NO	N/A
7	S	23 yrs	M	591344	18	29/9/18	2:00 AM	29/9/18	4:00 AM	10-10-2018	MVA	6 days	11	Left	4	no	Liver 2
8	HS	16 yrs	M	623477	18.5	20/11/18	12:00 PM	20/11/18	8:00 PM	12-06-2018	Assault	7 days	16	Left	4	yes	-
10	VS	28 yrs	M	660172	20	26/1/19	4:00 PM	27/1/19	6:00 AM	02-06-2019	MVA	5 days	9	right	3	yes	liver 2
11	RG	16 Yrs	M	660310	18	27/1/19	12:30 AM	27/1/19	22:27 PM	EXPIRED	MVA	-	N/A	left	1	no	liver 3, spleen 5, lung injury with flail chest, head injury
12	KK	18 yrs	M	685112	21	03-08-2019	5:00 PM	03-08-2019	9:00 PM	18/3/19	MVA	4 days	10	left	5	yes	spleen 5
13	IS	23 yrs	M	688208	19	13/03/19	4:30 AM	13/3/19	9:00 AM	19/3/19	MVA	1 day	6	right	3	no	liver2
14	BS	32 yrs	M	709433	20	15/4/19	11:00 AM	15/4/19	2:00 PM	23/4/19	Fall from height	2 days	8	left	2	yes	pelvic injury
15	HS	45 Yrs	M	714006	22	22/4/19	2:00 PM	22/4/19	5:00 PM	05-06-2019	MVA	8 days	14	Right	4	no	liver3
16	GS	25 yrs	M	717568	19	26/4/19	8:00 PM	27/4/19	4:00 AM	05-02-2019	MVA	0 days	5	left	2	yes	liver4, rib fracture
17	GS	32 yrs	M	749204	24	16/06/19	11:00 AM	16/06/19	1:15 AM	29/6/19	MVA	3 days	13	right	4	yes	liver3
18	SK	18 yrs	M	757348	21	28/6/19	9:00 AM	28/6/19	7:30 PM	14/7/19	MVA	4 days	16	right	4	no	pelvic injury
19	RC	45 yrs	M	779246	27	31/7/19	9:00 PM	08-01-2019	6:00 AM	08-10-2019	Fall from height	3 days	9	RIGHT	2	YES	liver3, Head injury

Sr. No	Name	ER Vitals				Blood products in 24 hours			DMSA scan	Laparotomy	Angioembolization	Urinary Tract complication	Management	follow up at 3 months	
		Initila SBP	Lowest systolic BP	HR	GCS	PRC	FFP	PLT						S.Creat	DMSA/USG
1	JR	110	104	105	15/15	2	0	0	left 86% Right 14%	N/A	N/A	N/A	N/A	0.9	right 18% left 82%
2	R	U/R	U/R	N/R	15/15	4	2	1	N/A	6/3/18. splenectomy plus left nephrectomy	N/A	N/A	N/A	1.1	N/A
3	RK	U/R	U/R	130	15/15	5	6	2	L 0% R 100%	13/5/18 splenectomy with diaphrgm repair	N/A	PERINEPHRIC ABSCESS	PCD insertion	1.4	L 0% R 100%
4	PR	130	80	94	15/15	0	0	0	left 52% Right 48%	N/A	N/A	N/A	N/A	0.64	left 52% RIGHT 48%
5	MW	110	110	82	15/15	1	1	1	L 60% R 40%	N/A	N/A	N/A	N/A	0.68	L 56% R 44%
6	KD	110	110	87	15/15	0	0	0	REFUSED	N/A	N/A	N/A	N/A	0.94	REFUSED
7	S	110	106	94	15/15	0	0	0	L 32% R68%	N/A	N/A	N/A	N/A	1.1	L 38% R 62%
8	HS	90	90	102	15/15	1	0	0	L 34% R 66%	N/A	N/A	urinoma formation	Dj Stenting	1.2	L 40% R 60%
10	VS	100	100	108	15/15	1	0	0	L 55% R 45%	N/A	N/A	N/A	N/A	1.3	L 50% R 50%
11	RG	U/R	U/R	N/R	E1VtM2	3	3	2	N/A	27/1/19 splenectomy	N/A	-	-	-	N/A
12	KK	110	110	72	15/15	2	0	0	N/A	-	yes (main renal artery)	N/A	N/A	1.4	N/A
13	IS	120	110	80	15/15	0	0	0	L 51% R 49%	N/A	N/A	N/A	N/A	0.75	L 51% R 49%
14	BS	110	110	80	15/15	1	2	0	L 44% R 56%	N/A	N/A	N/A	N/A	0.65	L 46% R 54%
15	HS	110	104	90	15/15	1	0	0	L 72% R 28%	N/A	N/A	Perinephric collection(hematoma/urinoma)	Dj Stenting	1.2	L 60% R 40%
16	GS	110	110	80	15/15	0	0	0	L 45% R 55%	N/A	N/A	N/A	N/A	0.9	L 50% R 50%
17	GS	100	100	150	15/15	2	0	2	L 80% R 20%	N/A	N/A	N/A	N/A		L 68% 32%
18	SK	90	90	128	15/15	1	0	0	N/A	N/A	yes (main renal artery)	Perinephric abscess	I/V ANTIBIOTICS		N/A
19	RC	96	96	120	14/15	1	0	0	REFUSED	N/A	N/A	N/A	N/A		REFUSED

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The Principal,
DMC, Ludhiana.

Subject: **Approval of Plan of Thesis.**

This is to inform you that the Faculty of Medical Sciences in its meeting held on 31.08.2018 has approved the plan of thesis of Dr. Vipul Bakshi, a student of your college for MCh Urology along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis

Pattern of renal injury in blunt trauma abdomen and it's management

Supervisor
Dr. Sandeep Sharma
Prof. & Head,
Dept. of Urology,
DMCH, Ludhiana.

Co-Supervisor
Dr. Jaspal Singh
Prof. & Head,
Dept. of Surgery,
DMCH, Ludhiana.

Dr. Harmandeep Singh Chahal
Asst. Prof.,
Dept. of Urology,

The student has to submit the four copies of thesis, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic.(if any).

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*
2. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF CHIRURGIAE

In

DEPARTMENT OF UROLOGY& KIDNEY TRANSPLANT

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES
FARIDKOT

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ABSTRACT OF PLAN OF THESIS

Title	**PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT**
For the degree of	Mch UROLOGY & Kidney Transplant
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Introduction: There is general consensus on the conservative management of minor renal injuries; however, there remains a divergence of opinion on management of major trauma with strong advocates of conservative as well as aggressive surgical management. Our study is to assess the pattern of renal injury, it's management and outcome in our institute.

Aim of Study: To determine the grade of various renal injuries in blunt trauma abdomen and methods adopted for their management.

Materials & methods: A prospective study to evaluate Pattern of renal injury and it's management in patients of blunt trauma abdomen presenting in DMCH, Ludhiana from Feb 2018 – Feb 2019 (12 months). The outcome in terms of recovery, no change and death will be recorded.

Clinical Significance: To observe the various grades of renal injury along with their management and outcomes.

Keywords: Surgical management, Renal injury, Blunt Trauma Abdomen, Conservative management

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Candidate	Co-supervisor	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis title **"PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT"** exist in the Department of Urology & Kidney Transplant, Dayanand Medical College, and Hospital Ludhiana & will be provided to the candidate. We will see that the data being included in the thesis are genuine & is collected by the candidate himself under our supervision & guidance.

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Approved: Yes / No

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Approved: Yes / ~~No~~

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PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

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5	TITLE OF THE TOPIC	**PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT**

6. BREIF RESUME OF THE INTENDED WORK

6.1 NEED FOR STUDY

Trauma is the leading cause of death and disability worldwide. Renal trauma occurs in 8-10% of all blunt and penetrating abdominal injuries [1]. Eighty to ninety percent of cases involve blunt rather than penetrating injury.[2]. Blunt trauma due to motor vehicle is the most common mechanism of renal injury. Incidence is higher in male with male to female ratio of 3:1. Serious renal injuries are frequently associated with injuries to other organs. Multiorgan involvement occurs in 75% patient with blunt trauma abdomen.[3] Kidney is the most common injured organ of genitourinary system. Seventy five to eighty percent of renal injuries are classified as minor injuries (Grade I-III). Renal injuries are graded using the classification of the organ injury severity committee from the American Association of Surgery in Trauma (AAST).[4] This includes extent of hematoma, depth of laceration, involvement of collecting system and severity of vascular injury.

CT is the best method for assessment of stable patients with renal trauma. CT is more sensitive and specific than IVP, US or angiography, since it accurately defines the location of injuries, easily detects contusions and devitalized segments, visualizes the entire retroperitoneum and any associated haematomas, and includes other abdominal and pelvic structures. It demonstrates superior anatomical details, including the depth and location of lacerations and the presence of associated abdominal injuries, and establishes the presence and location of the contralateral kidney.

Conservative management consists of regular monitoring of vital signs, physical examination, and laboratory analysis. Bed rest is proposed until

clinical signs become stable and macroscopic hematuria has cleared. The role of antibiotics is not clear, but IV broad spectrum antibiotics should be used if there is suggestion of damage to the collecting system and urine leak, to prevent secondary infection of the retroperitoneal hematoma.

There is a general consensus on the conservative management of minor renal injuries; however, there remains a divergence of opinion on management of major renal trauma with strong advocates of conservative as well as aggressive surgical management. Most patients with major renal trauma can be followed expectantly, with delayed intervention only as needed due to improvements in imaging modalities.[5] Urinalysis provides rapidly available information in patients who may have a renal laceration. Sonography may be used in patients with blunt trauma abdomen and possible renal injury. Indication for surgery in renal trauma are avulsion of the renal pelvis, injuries to vascular pedicle and life-threatening hemodynamic instability.[6] The relative indications for renal exploration can be nonviable tissue, urinary extravasation, incomplete staging and arterial thrombosis. These injuries may coexist with bleeding and it's this combination that lead to renal exploration.[7] Vascular injury can also be effectively treated with angiographic procedures like super selective renal embolization.[8] Also, there are not many documented studies which elaborate renal function outcome after renal trauma. Henceforth, this study has been planned to study the pattern of renal injury in blunt trauma abdomen, its management and outcome with respect to renal functions at our institute.

6.2 REVIEW OF LITERATURE

Blunt trauma is caused primarily by motor vehicle collisions, followed by falls, contact sports and pedestrian accidents.[9] The evolution in management of renal trauma has been made possible by advances in imaging. Decisions about radiographic imaging in cases of suspected renal trauma are based on clinical findings and the mechanism of injury. Since most renal injuries are not significant and resolve without any intervention, many attempts have been made to identify which patients could be spared the discomfort, radiation exposure, possible allergic reaction, time and expense of a radiographic evaluation. Indications for radiographic evaluation are gross haematuria, microscopic haematuria with hypotension, or the presence of major associated injuries. However, patients with a history of rapid deceleration injury, clinical indicators of renal trauma or associated injuries need immediate imaging to rule out ureteral avulsion or pedicle injury, with non-visible haematuria without shock after blunt trauma having a low likelihood of concealing significant injury.

CT scanning is more sensitive and specific than IVP and Ultrasound scanning. It provides greater anatomical detail and associated injuries to any intra-abdominal organs. For renal injury, a scan should also be performed after injection of intravenous contrast to delineate the collecting system (delayed phase). CT scanning is the only imaging modality that can provide information required to grade renal injuries as part of the AAST renal injury grading system. For this purpose, there needs to be an arterial, venous and a delayed excretory phase to assess all pedicle injuries.[10] Therefore, CT is the imaging of choice in renal trauma.[11] In 2010, Dugi et al showed a correlation

between important CT finding such as large perirenal hematoma, intravascular contrast extravasation, medial renal laceration and the need for urgent intervention.[12]

Grade I injuries are the most common type of renal injury (75-85% cases) and in most cases are managed conservatively.[13] In Grade II injuries, most cases are also treated conservatively in stable patients.[14] Grade III injuries can be managed conservatively in stable patients, but for many of them an expectant approach should be considered.[15] Grade IV injuries can be particularly challenging; sometimes they can be observed expectantly, but often require either urgent or delayed repair.[16] The management of grade V injuries is more controversial, since conservative, interventional and surgical approaches have been reported. Usually, Grade V injuries are an absolute indication for exploration, but stable patients with only parenchymal injury may be safely treated conservatively.[17] Sahai et al determined the feasibility of a non-operative approach to blunt grade V renal injury and found that conservative management is feasible in patients who are hemodynamically stable at presentation.[18] Interventional procedures maybe indicated in more stable patients as well as in postoperative patients with persistent or recurrent haematuria.[19] The main indication for angiography are: embolization for active haemorrhage, pseudo-aneurysm and vascular fistula.[20] With advances in embolization techniques, there is an increasing body of literature supporting the use of angioembolization in the management of grade IV and grad V injuries.

The goal of renal exploration following renal trauma are control of hemorrhage and real salvage. . Indication for surgery in renal trauma are

avulsion of the renal pelvis. injuries to vascular pedicle and life-threatening hemodynamic instability.[6] The relative indications for renal exploration can be nonviable tissue, urinary extravasation, incomplete staging and arterial thrombosis. In the case of exploring an injured kidney, nephron sparing is the primary goal, but in many cases total nephrectomy may be deemed as inevitable for uncontrolled hemorrhage.

Conservative approach is not without complications. Extravasation of urine is the most common complication of renal trauma. Urinomas occur in 1-7% of cases and consists of a collection of urine that may be encapsulated, although thy can manifest as free fluid. Delayed phase CT imaging is the study of choice in the diagnosis of urine leaks and urinomas. Urinomas may also be complicated by superinfection or perinephric abscess formation. In most cases, a small urinoma will be reabsorbed spontaneously and further intervention is not needed. If the volume does not decrease, or if it increases, further intervention will be necessary such as ureteral stenting with or without percutaneous drain placement. Robert et al in his study showed pyelonephritis (9%), residual perinephric fluid collection (36%) and ureteral stenting for urinary extravasation in 36% cases.[21] Hass et al described a high salvage rate using ureteral stents in patients with renal trauma and urinary extravasation.[22] Alsikafi et al reported 9% patients with major blunt injury and urinary extravasation required ureteric stenting for persistent extravasation, while 91% had spontaneous resolution.[23]

It is recommended that first follow up be scheduled for three months following hospitalization. The follow up should include a physical examination, urinalysis, selective re-imaging and renal function test. Nuclear scans are

useful for tracking recovery, particularly following renal reconstruction. Assessment of residual renal function with Dimercapto-Succinic Acid Renal Scintigraphy (DMSA) has been performed by some centres for injuries grade III and above.[24] In a study by Long et al, 65% patients with urine leak at the time of diagnosis underwent DMSA scan at 4-6 months. In these cases, operative management and >25% devitalized parenchyma at diagnosis independently predicted long term renal function.[25]

6.3 AIMS AND OBJECTIVES OF THE STUDY

1. To determine the pattern of renal injuries in blunt trauma abdomen.
2. To study the effect of management protocols on the outcome.

7.0 MATERIALS AND METHODS

7.1 SOURCE OF DATA:

This prospective study will be conducted in Department of Urology & kidney Transplant, Dayanand Medical College & Hospital from February 2018 to February 2019.

7.2 METHOD OF COLLECTION OF DATA

Inclusion Criteria

- Patients of age group above 13 years presenting with renal injury in blunt trauma abdomen
- Associated injuries
- Either gender

Exclusion Criteria

- Age <13 years
- Penetrating injury
- Iatrogenic injury
- Patients who died within 6 hours after reaching emergency

Demographic profile of all the patients will be noted down. The date and time of injury along with date and time of hospital arrival will be noted. A note of associated injuries will be made. Renal injury will be graded according to the American Association of Surgery in Trauma (AAST):

Grade I: contusion or non-enlarging subcapsular perirenal haematoma, and no laceration

Grade II: superficial laceration <1 cm depth and does not involve the collecting system (no evidence of urine extravasation), non-expanding perirenal haematoma confined to retroperitoneum

Grade III: laceration >1 cm without extension into the renal pelvis or collecting system (no evidence of urine extravasation)

Grade IV

- laceration extends to renal pelvis or urinary extravasation
- vascular: injury to main renal artery or vein with contained hemorrhage
- segmental infarctions without associated lacerations
- expanding subcapsular haematomas compressing the kidney

Grade V

- shattered kidney
- avulsion of renal hilum: devascularisation of a kidney due to hilar injury
- ureteropelvic avulsions
- complete laceration or thrombus of the main renal artery or vein

A note of vitals at the time of arrival to our hospital will be made. Number of blood products transfused will be noted. Patients will be kept under monitoring throughout the first week and daily Heart rate, blood pressure, hemoglobin and urine output will be charted. DMSA scan will be performed in first 7 days. A note of any surgical intervention or angioembolization along with the procedure details will be done. Complications and their management during the hospital stay will be noted. On follow up after 3 months, patient will be examined clinically along with serum creatinine levels and a DMSA/USG scan.

Parameters Studied

Following evaluation was done in all the patients-

1. Grade of injuries according to AAST and their management whether managed conservatively or by angioembolisation or surgical procedure.

2. Complications (Urosepsis, Urinoma, Peri-renal abscess, renal failure).

3. Management of complications (I/V antibiotics, Nephrectomy, Dialysis, Ureteral stent, percutaneous drainage)

4. Assessment of early and delayed relative function of injured kidney with the help of DMSA renal scan within 7 days and second DMSA scan/USG, 3 months after trauma

Statistical Analysis

Data will be described in the terms of range, mean±standard deviation, median, frequency (number of cases) and relative frequencies (percentage) as appropriate.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

Post-trauma investigations including, but not limiting to:-

1.) **PATHOLOGICAL**- Complete hemogram

2.) **BIOCHEMICAL**- Renal function test profile

3.) **RADIOLOGICAL**- USG whole abdomen and DMSA scan

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Yes attached herewith.

8. LIST OF REFERENCES

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PROFORMA

S.no.

Name: S/o,W/o,D/o Address:

Income MRD no.: Adm no.:

Education:

Date of injury: ____/____/_____

Time of injury:

Date of hospital arrival: ____/____/_____

Time of hospital arrival:

Age: Sex: BMI:

Date of discharge: Discharge status:

ICU length of stay (if known):

Co-morbidities:

AAST grade kidney injury: Which kidney:

Other Injuries:

Pelvis fracture: Y N Rectal: Y N Small bowel: Y N

Colon: Y N Liver: Y N Spleen: Y N

Pancreas: Y N Spinal Cord: Y N Head injury Y N

ER or initial hospital VITALS:

Initial SBP: Lowest SBP in ER: HR:

GCS:

Blood products:

PRC in first 24 hours:

FFP in first 24 hours:

PLTs in first 24 hours:

Signature of Candidate **Signature of Supervisor**

Hospital stay monitoring:

	HR	BP	Hb	Urine output
DAY 1				
DAY 2				
DAY 3				
DAY 4				
DAY 5				
DAY 6				

DMSA SCAN in first 7 days:

Laparotomy:

Date of laparotomy: ____/____/_____

OPERATIVE FINDING:

Angiography:

Date of angiography: ____/____/_____
Was stenting or angioembolization done?
Embolization: Internal iliac complete – R L External iliac – R L Branch of internal iliac – R L
Renal artery complete – R L Renal artery selective – R L Perinephric artery
Other
Stent: Iliac artery – R L Renal artery – R L Other

Was operative management needed other than angio procedures:

PROCEDURE:

Surgeon

Anaesthetist

Ot no:

Intra-op details:

Signature of Candidate **Signature of Supervisor**

Was there a urinary tract related complication:

Date of urinary tract complication: ____/____/_____

Complications:

Management of complication:

Follow up after 3 months:

1. Any fresh complaint

2. General examination

3. Serum Creatinine

4. DMSA Scan/USG done:

Signature of Candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o..... am willing to participate in the study **"PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

....

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____ निवासी _____ इस शोधकार्य "**PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT**" में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर

नाम:

रोगी के हस्ताक्षर/अंगूठे का निशान

नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫ਼ਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"PATTERN OF RENAL INJURY IN BLUNT TRAUMA ABDOMEN AND IT'S MANAGEMENT" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

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ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

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ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

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ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ